THE GEOGRAPHY OF MONTANA

DAVIS AND Mc BAIN

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Map Studies. — 1. From the political map of the United States in your textbook determine what proportion of the boundary between our country and Canada is also the northern boundary of Montana.

2. Using the scale of miles, determine the distance across Montana from east to west. Using a railroad time table, compare this distance with the shortest railroad mileage across the state from east to west.

3. By means of east-west and north-south measurements estimate the area of the state. Compare the result with the area given in the Appendix. Which states are larger than Montana?

4. Compare the area and population of Montana with those of France. What is the population per square mile in each case? How many times as large as Illinois is Montana? How many times as great is the population of Illinois?

5. Compare the distance across Montana from east to west with that from New York to Chicago. Using a time table, compare the time required to travel from the most western station in Montana to the Dakota boundary with that required to go by rail from the last eastern Montana station to Chicago.

6. Name all the states which border upon Montana; the Canadian provinces. What parallel marks the northern boundary of Montana? What natural boundary marks most of the line between Montana and Idaho?

7. From the map on the following page estimate the approximate elevation of the place where you live. The average elevation of all the earth's land surface is 2200 feet. What proportion of Montana's surface do you estimate to be higher? What parts of the state have an elevation of less than 2000 feet?

8. The Missouri River is formed by the junction of three rivers near Three Forks. What is the source of each of these rivers? Account for the name of each. Find three branches of the Missouri in Montana; notice that the largest of these crosses the boundary into Dakota before uniting with the Missouri. Account for the fact that the Missouri is a clear stream in its upper course and very muddy in its lower course.

9. Where would you go in Montana if you wished to find a hill which drained from one side into the Atlantic and from the other into the Pacific? What two rivers in Montana flow toward the west and drain at last into the Pacific Ocean? Montana is the only state whose surface drains into three oceans; what part of Montana drains into the Arctic Ocean?

10. On the black-and-white map (page 5) locate the continental divide. In general would a train be going uphill or downhill in going from Butte to Missoula? Locate the following mountain ranges — Beartooth, Bitter Root, Mission, Belt, Little Rockies, Crazy.

11. Locate by county all Montana cities which have a population of more than 10,000 people. Locate the county in which you now are and name the counties which border upon it. Write the names of the five counties which seem to you largest. Referring to the table in the Appendix, how many of the five largest did you name?

12. On Fig. 1, locate as accurately as you can the scene represented by each picture in this supplement. See if the map explains the smoothness or roughness of the land in each case. Also, identify on the map the streams and mountains wherever these are shown.

Fig. 1.

Fig. 2. — A nine hundred acre wheat field in eastern Montana

Here you see a typical eastern-Montana landscape — gently rolling farm land with hills in the distance.

Why "Montana" — the mountain state? — A glance at the map of the Western States (main text, Fig. 175) shows clearly the two natural physical regions into which Montana is divided. With surface resembling that of the Dakotas, the Great Plains region extends far into the state. The elevation of these plains at the eastern boundary is in most places more than 2000 feet, though the Missouri and Yellowstone valleys include small areas lower than this.

Two natural surface divisions

The map might at first sight appear to indicate that the eastern section of Montana is a level plain, but traveling across the state from east to west proves this not to be true. Nearly everywhere the vast stretches of level land are surmounted by hills, buttes, and rim rocks. In most places something which travelers from the plains states are likely to call "mountains" may be seen, and these become more rugged and more frequent as one approaches the mountains themselves, which at first seem to stand out upon the plains.

1. Eastern Montana not a level plain

Eastern Montana, north of the Missouri River, is comparatively level. It is part of the region once covered by the great ice sheet (main text, Fig. 8). South of the Missouri the valleys are more deeply cut and there are more rocky hills.

2. Surface north and south of the Missouri differs

The Bad Lands common to southwest South Dakota, northeast Wyoming, and southeast Montana have been eroded by action of water and wind until the rocks show many strange forms, some resembling temples, towers, and castles. Vegetation in the Bad Lands is usually scant. Many fossil remains of prehistoric animals have been found in this region.

Like eastern Washington and Idaho, the western third of Montana is mountainous. The main range of the Rocky Mountains, which forms the Continental Divide, is paralleled by other ranges, most of these being east of the divide itself. Ranges are close together and valleys narrow, though a few ranges on the east of the divide are many miles out upon the high plains.

3. Continental Divide and neighboring ranges

Fig. 3. — In the Bad Lands

The highest range, the Beartooth, includes Granite Peak (altitude 12,850 feet), the high-

4. Highest and lowest points

est point in the state. Most of the mountainous section of the state has an elevation in excess of 5000 feet, though many valleys are much lower. According to the United States Geological Survey the lowest point in Montana is in the Kootenai Valley, 1800 feet.

The Continental Divide separates drainage systems of Atlantic, Pacific, and Arctic slopes. The Missouri from its formation at Three Forks by the union of the Jefferson, Madison, and Gallatin rivers, breaks through the mountains north of Helena and enters the plains, flowing northeast. At Great Falls the river descends in several falls and rapids more than 500 feet. The rest of its course is mainly in an easterly direction.

How Montana is drained

West of the Divide is the Kootenai, which rises in Canada and flows across the northwestern corner of the state, draining only a small section of Montana. Clark Fork, rising not far from Butte, flows northwest. As Clark Fork of the Columbia, it crosses the line into Idaho. It receives the Bitter Root and other large tributaries. Small streams rising in the northern part of Glacier Park drain into the Saskatchewan.

If Montana's surface be considered as a whole, mountains are seen to be the most

Courtesy of J. W. Johnson

Fig. 4. — A sweet cherry orchard in the Bitter Root Valley

Contrast this scene, typical of western Montana, with Fig. 2.

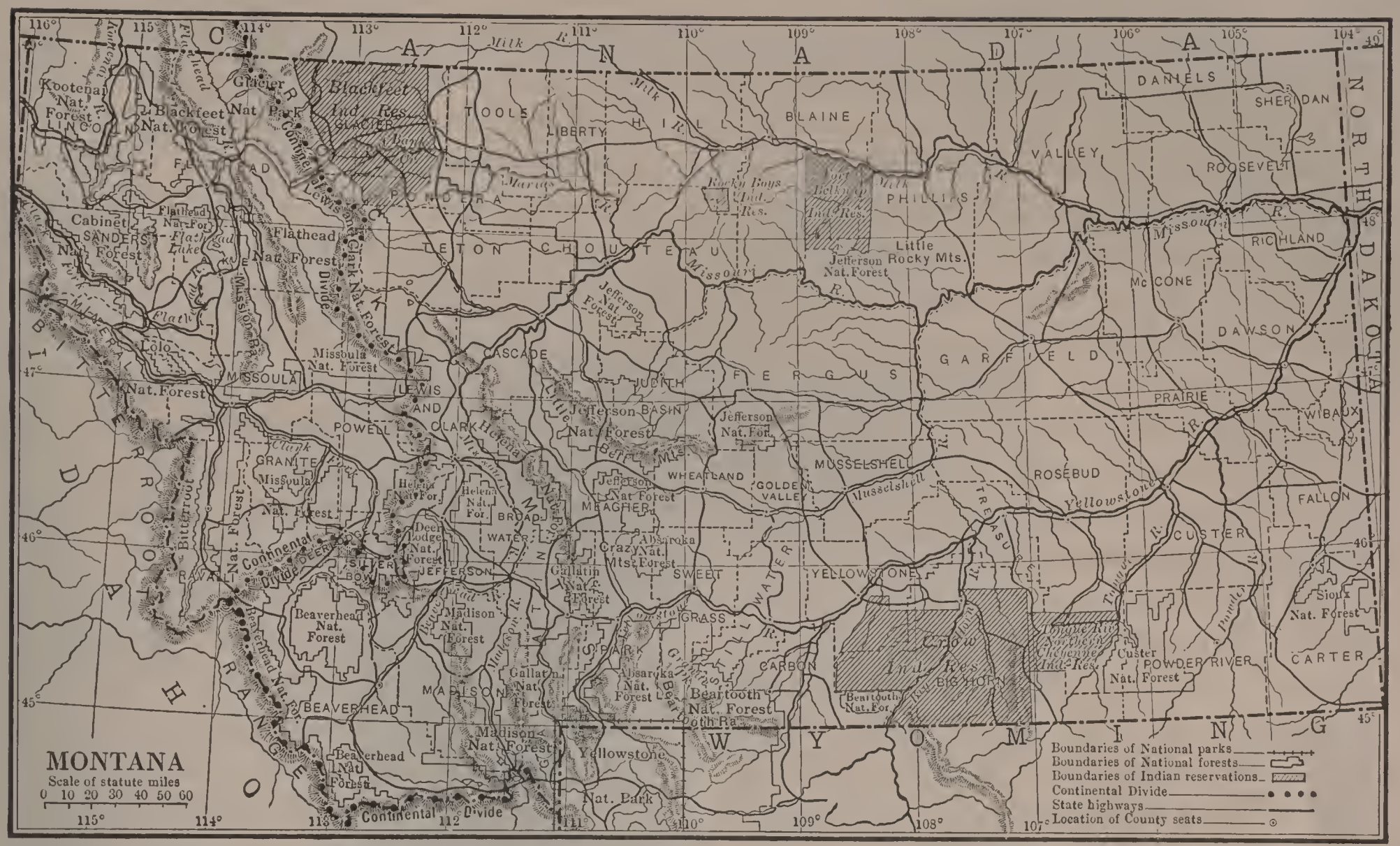

Fig. 5. — Drainage and transportation map of Montana, showing also Indian Reservations and National Forests

characteristic feature. In the western half of the state one is hardly ever far from them; in many places their rugged tops outline the horizon on all sides. Truly Montana is rightly named — the mountain state.

Facts to be especially well fixed. — 1. Area of the state. 2. Approximate distance across Montana from east to west. 3. Two surface divisions. 4. Location of highest and lowest elevations. 5. The two principal drainage systems.

Problems for independent study

Mean elevation

State	*Feet*
Montana	3400
Idaho	5000
Wyoming	6700
Oregon	3300
North Dakota	1900
South Dakota	2200
Washington	1700
Colorado	6800
Utah	6100
United States (exclusive of Alaska)	2500

1. What does "mean elevation" mean to you after reading the preceding paragraphs? 2. How much above Montana's mean elevation is Granite Peak? 3. How much lower than the mean elevation is the lowest point in the Kootenai Valley? 4. Compare the mean elevation of Montana with that of adjoining states. With that of the United States.

5. The Kootenai and Flathead excepted, no river in Montana flows south. Account for this fact.

How the climate and other natural resources of Montana have favored settlement. — Most of Montana is in that part of North America which has "mild summers and extreme winters" (main text, Fig. 12). This does not mean that summers are never hot; in at least half of the state, many days are as hot as in the North Central States, though the nights are usually

Relation between Montana's climate and agricultural possibilities

1. What is meant by "mild summers and extreme winters"

cool. "Extreme winters" also is not a term which, as used here, indicates long-continued severe cold.

For several reasons it is difficult for those who are not familiar with mountain regions to understand Montana climate. It may be excessively cold up in the mountains and merely cool, or moderately cold, in the valley. Vigorous winds may blow almost constantly in one valley while there are few windy days in another. Wind-swept plains are colder than protected valleys and seem even colder than they are.

2. How climate varies locally

The prevailing dryness of the atmosphere greatly decreases the discomfort of cold or hot weather when compared with the same or less extreme degrees of temperature in more humid climates. Thus those who live in Illinois, Iowa, or Kansas read of the extremely low temperature occasionally recorded in Montana and wonder how friends or relatives can "stand such cold." Montana visitors who go East are likewise surprised to feel that they are "freezing with a damp cold" even when the thermometer is not registering a low temperature.

3. How dryness modifies the effects of extreme temperature

Another peculiarity of the Montana climate is the thin air common to regions of high altitude. This results in brilliant sunlight with great warmth while the air may be uncomfortably cool in the shadows. The air cools rapidly after sundown, resulting in cool nights, especially in the higher sections of the state.

4. How altitude affects climate

The operation of many well-known climatic laws is easily discovered in Montana. Temperature always decreases as altitude increases, except where cold air sinks to the bottom of small, pocket-like valleys, which may on that account be colder at times than the hills surrounding them.

Montana lies in the region of prevailing westerlies (main text, Fig. 242). This accounts for the warm winds, known as Chinooks, which so frequently melt the snows and raise the winter temperatures (main text, pages 147, 184). Winds from the west are descending as they pass over the state; how does this affect the temperature (page 235)?

5. Chinooks and their effects

In seeking an explanation of the warm Chinook winds, the cause of rainfall is also discovered, and it may be seen why Montana is mainly a region of deficient rainfall (main text, Figs. 13, 18). The winds, passing over several mountain ranges to the west, are cooled and lose a large portion of their moisture, giving parts of Washington and Oregon heavy precipitation. (See main text, page 132.) Not only have the winds parted with most of their water vapor, but since they are descending, their temperature increases and their water-carrying power is greater. During much of the time they are drying winds instead of rain-bringing winds (main text, pages 232–235).

6. Why Montana has deficient moisture

Rainfall may be influenced locally by mountains. Eastern slopes usually have less rain or snow than western slopes. As an illustration, precipitation at Bozeman averages nearly twenty inches and at Livingston, not more than twenty-five miles distant, it is about fifteen inches. Many ranges are snow-covered during more than half of the year while others may never have snow to cover their barren surface. One slope of a range may be covered with trees while the other is bare.

7. How mountains affect rainfall locally

"Talking about the weather" is sometimes regarded as idle talk, but there are practical

reasons for understanding climate and its local variations in Montana. Many settlers have tried to establish homesteads upon slopes too dry for farming. Two regions of equal annual rainfall might at first thought seem to be equally valuable for agriculture, but the distribution by months may be as important as the total amount. A few inches of rain in May, June, and July may insure a crop; the same amount in August, September, or October may prove of little value, or even injurious to some crops. Another practical application of climate relates to the number of days between killing frosts. Length of frost-free period is far more important agriculturally than the average annual temperature.

8. Why is it necessary to study our climate

Courtesy J. S. Pitts

Fig. 6. — A forest near Libby

Can you name these trees?

There are great general differences between the climate of the plains part of the state and that in the mountainous region. In general, there are more wind and greater extremes of heat and cold in the eastern part of Montana and a longer growing season. In the west, as has been noted, there is much greater local variation, due to mountain ranges, and there is often a very short frost-free period. Even in some of the most important agricultural valleys, heavy snowfall in June is not unheard of, while occasionally there is snow in July. Frosts may occur in some of the irrigated valleys in all months except July; in a few hay-producing valleys heavy frosts occur in every month.

9. How plains and mountain sections differ in climate

What are Montana's natural resources? "Natural resources" is an expression with a changeable significance. It means game to the hunter, fish to the fisherman, and mineral wealth to the miner. To the farmer it may mean fertile soil, well-distributed rainfall, or water for irrigation.

The other natural resources of Montana

1. How natural materials and conditions become resources

Fur-bearing animals, formerly trapped by the Indians and later by white traders, were long the chief product of the territory and still remain important. These traders followed the rivers as the Indians had done and as the railroads in many cases do now. St. Louis was their final market (main text, page 79). We no longer think of game as the most important source of wealth; but the beaver, mink, muskrat, and other fur-bearing animals still make a living for many people in the state. Deer, ducks, trout, and other kinds of game which are so abundant are protected

2. What resources the fur-traders used

by game laws so that hunters and fishermen of the future may share with us the pursuit of game. Such natural resources are worth preserving, even though we may not think of them as being worth money.

To Indians and fur traders, forests were not important as natural wealth. A pole now and then, material for boats and rafts, and fuel they needed; otherwise the forest had its principal meaning as the home of game or an obstacle to travel. The mineral

3. Why forests and mines were not at first important

Fig. 7. — Feeding wild hay in a valley too high for agriculture

wealth, too, upon which we now so much depend, had not been discovered.

The first mineral discoveries were those of gold and silver. Some of the richest fields were at Bannack and Virginia City and at Helena. Wherever gold was found, thousands flocked in its quest. The places just named became in turn the territorial capital because they were the largest settlements. When gold was so far exhausted that a day of hard work no longer "panned out," the crowd moved on, leaving the field to be worked over by more thorough processes many years later.

4. How mineral wealth was developed

Most of the gold and silver now produced is found in combination with other metals and must be separated by very complex and expensive processes. These can be conducted profitably only on a large scale. When copper mining developed, the forests took on new value, since mining timbers would have been almost prohibitively expensive had not the supply been near at hand.

Gold, silver, copper, lead, and coal were all being produced in large quantities before 1900. Zinc, precious stones, manganese, petroleum, natural gas, are other mineral resources which have helped Montana to produce wealth since 1905.

The peculiar form of natural wealth upon which the grazing industry first developed was found on the vast plains, where the native grass cures into hay without being cut. Both cattle and sheep may winter with little or no other sustenance and usually with little shelter except what nature affords. Some varieties of native bunch grass are almost like grain in their nutritive value. Large numbers of cattle are fattened for beef upon wild hay alone.

5. What resources are of value for grazing

The soils in many parts of the State require only a sufficient supply of water to produce bountiful crops; such irrigation

projects as those in the Yellowstone Valley near Billings or the Milk River Project insure good crops almost every year. The Gallatin and Judith Basin and other valleys produce remarkable yields of grain. Scientific methods and more general practice of summer fallowing will utilize increased acreage in dry farming. By conserving moisture natural resources of an unleached virgin soil can be used which are lost when unskilled methods are employed. Farming practices, however, must differ widely from those in regions of abundant rainfall. Much loss and hardship have resulted because settlers have not understood how to farm where the great problem is conservation of moisture, and because the attempt has been made to farm land which might more profitably be left for grazing.

6. Farming resources and their peculiarities

In considering the natural resources for farming, it may be noted that in many instances the brief frost-free period, ranging from 71 to 140 days, is fully compensated for by the long days of summer sunlight. It is the number of heat units which counts in making and maturing crops rather than the number of days.

To the great natural resources which have been named must be added the abundant water power of Montana. The streams in the western part of the state rise in very high altitudes. They descend through mountain valleys and gorges with steep slopes. There are many natural falls and cataracts and favorable sites for building dams. The construction of power dams in level regions often proves impracticable because the lake or reservoir formed may inundate large areas of valuable agricultural land. This is a difficulty seldom encountered in the narrow valleys of western Montana. Natural rock foundations make dam building comparatively easy.

7. How water power is made a resource

Facts to be especially well fixed. — 1. Differences between climate of eastern and western Montana.

Courtesy Great Falls Commercial Club

Fig. 8. — Black Eagle Falls of the Missouri River

One of three power projects near Great Falls.

2. Chinooks and their effects. 3. Importance of local variations in climate. 4. The principal natural resources.

Problems for independent study. — 1. Of the influences upon climate listed on page 240 of your main text, which appear to you to have the greatest effect upon climate in Montana? State your reasons fully.

2. How do you account for the fact that Miles City has colder winters and warmer summers than Seattle?

3. The average annual temperature in the four cities listed below varies only about one degree. Account for the fact that the January-July variation is much greater in the last two than in the first

two. Which shows the greatest differences between January and July average temperatures?

	Annual	*January*	*July*
Anaconda	42.7	24	62.7
Missoula	43	21.3	63.2
Glendive	42.9	11.3	72.7
Havre	41.9	13.5	68.1

4. Show several ways in which Chinook winds are injurious to farmers. To live stock growers. Of what value are these winds?

5. The average frost-free period is estimated at 108 days in Butte and 115 days in Missoula. After studying Fig. 1, account for this difference.

Courtesy National Forest Service

Fig. 9. — Forest fire lookout cabin near Missoula

Precautions of this kind help to keep down the annual loss caused by forest fires.

6. The seven principal occupations in the United States are named on page 213 of your main text. Which of these is least important in Montana? Which of the natural resources in our State makes each of these occupations possible?

What purposes are served by the forests of Montana? — The forest lands of Montana are in the mountainous portion of the state. The heaviest stand of timber is west of the Continental Divide, four fifths of all the timber being in the Missoula and Kalispell districts. The eastern slope of the Rockies and outlying ranges have a lighter stand, and the trees are shorter and yield a lower per cent of high-grade lumber. Why?

Where the forests are

Timber lands of Montana are classified as (*a*) productive commercial areas and (*b*) protective forest areas. (See main text, page 221.) The productive commercial area is more than thirteen million acres, of which one half is covered with mature timber and one half by reproduction and young growth. About three tenths of the productive forest is privately owned; fifty-eight per cent is National Forest and the remainder about equally shared by National Parks, Indian reservations, and the state.

How timber lands are classified

Most of the protective forest area is owned by the federal government. It is important in protecting the land from erosion and in conserving water supply. Timber reserves retard melting of the snow in the spring and make available a more steady supply for irrigation and water power.

Most forest trees in Montana are of cone-bearing varieties — pine, fir, larch, spruce, hemlock, and cedar. Cottonwoods and willows grow along the streams in every part of the state. Practically no hardwood lumber is produced in the State.

From Fig. 5 it may be seen that a large part of the area of Montana is included within the National Forests. About 16,000,000 acres are under the direct control of the federal government. Not all of this area is

covered with timber, and it is not the intention of the government to interfere with development of the state's resources. Land suitable for agriculture is open for settlement. Sites suitable for water-power development may be utilized, but the government does not permit any one to acquire a monopoly of such power or to hold sites without developing them. National forests are valuable for grazing. Forest reserves are the most extensive control exercised by the United States in the interest of conservation, but there are Indian reservations, bird reserves, a bison range, and others designed to conserve mineral resources. Why does the national government control these? (See main text, pages 215–224.)

Forest reserves do not interfere with improvements in the state

Fig. 10. — A forest-tree nursery in Lolo National Forest

The Government is solving the problem of keeping forests on the mountains by planting many thousands of young trees on cut-over slopes.

Courtesy National Forest Service

Fig. 11. — Cattle grazing on the Beaverhead National Forest

What mining means to Montana. — The rich gold discoveries of California in 1848 brought gold-seekers, the "forty-niners," from every part of the earth. Prospectors began to look for gold everywhere in the West and soon found the rich strikes at Bannack and Virginia City and later at Helena. No one actually knows how much gold was taken from any of these gulches, but estimates vary from $100,000,000 to $200,000,000 for Virginia City, Alder Gulch, which may be considered typical. From a suddenly assembled population of many thousands, this former great mining camp has declined in population until only a few hundred people are left.

The first mining at Virginia City and vicinity was for native or pure gold. (See main text, page 132.) This was panned or cradled (main text, pages 132–134); then followed the sluice-box and placer mining. After these methods ceased to be profitable, the great gold excitement was over and population declined rapidly. Dredge-mining took the place of stone and gravel, "the earth turned upside down" to the depth of twenty feet or more.

How gold mining has changed

In quartz mining metals are not found in a native or pure state but are in the form of compounds called ores. Ores occur in veins, not horizontally placed as we are apt to think from what we know of coal veins, but often almost vertical in position, following cracks or fissures caused by breaking of the earth's crust. Long ago hot water deep in the earth dissolved mineral compounds. Full of such solutions, it rose in the earth fissures and cooled. Cool or cold water cannot hold as much mineral in solution as hot water does, and as such mineral compounds were deposited they gradually filled the fissures. These cracks filled with mineral deposit we call veins. They are exceedingly irregular in shape and mining must follow them wherever they lead.

How ore veins develop

Courtesy National Forest Service

Fig. 12. — A cut-over area in the Bitter Root National Forest

Note the brush piled for burning, to prevent the spread of fires; the trees left for seed; and the low stumps.

The most important mines are in or near Butte in Silver Bow County. (See Fig. 154.) Though this was at first a gold camp, silver-bearing quartz soon proved more profitable, since gold was never exceedingly abundant. Copper had been noticed from the first, but without railroads the high cost of transportation took away all possible profit from copper operations. In time the relative importance of gold, silver, and copper was the reverse of what it had been before. Since about 1880 the rank has been copper, silver, gold. It was not alone

Why copper mining became more important than gold mining

cruder early methods. Worked-over gravel dumps were again worked, and lower grade gravels were made to yield a steady income. Gravel which yielded only five to fifteen cents' worth of gold per cubic yard offered little chance for exciting "strikes," but dredge mining in the vicinity of Virginia City was conducted profitably until very recently. The ground worked over by a large dredge is an impressive lesson in the value which is placed upon the yellow metal. In front of the boat may be rich farm land; behind it,

the coming of the railroad which increased the importance of copper mining by making marketing less expensive. Great progress in electrical engineering was made about the same time.

In the copper mines of the Butte district vertical shafts are constructed, some of them being 3400 feet deep. From these are run out horizontal passages along the veins, usually at each one hundred or two hundred feet; these are connected by passages. The volume of the *stopes* from which the ore has been taken varies from five to ten times that of the passages. In one mine the total length of all passages is more than seven hundred miles. How long does it require for you to walk a mile? If it were possible for you to walk through all these passages, how many days would it take for you to "explore" this one mine?

1. What a large copper mine is like

Ore is first loosened by blasting. A blast usually loosens waste rock along with the ore. This waste is piled back in one of the *stopes* which has already been opened and *timbered*, or made safe and strong by wooden supports instead of the rock and ore which may have been cracked or removed in mining.

2. How ore is taken out of the earth

The loosened ore is shoveled into chutes which carry it into mine cars on the main levels. Electric locomotives haul the cars to stations where it is dumped into receiving pockets in the shaft. From these it is loaded into *skips*, hoisted to the surface, and distributed in the main bins. Electrically operated trains then carry it to the reduction works, where the ore is smelted.

Smelting and refining separate the metal from the ore. One of the principal copper-producing ores is *sulphide of copper*, a compound of sulphur and copper united in such a way that it does not look like either sulphur or copper. Getting rid of the sulphur is the chief problem in handling this ore, but in all ores many ingredients must be eliminated before pure copper results.

3. How "blister" copper is made from ore

Courtesy Anaconda Copper Mining Co.

Fig. 13. — A copper mine

Hauling ore from chutes to shaft. Notice the electric light.

The great reduction plant where ore is smelted is at Anaconda, twenty-six miles from Butte. (See main text, Fig. 155.) It was placed here because this was the nearest suitable location where an abundant supply of water could be had. The works are arranged on a hillside because gravity helps in moving material from one department to another.

The ore as it is received from the mines is in particles ranging from the fineness of dust to pieces a foot or more in diameter. Mixed with it are large quantities of rock which have no value. All material is first run through the *concentrator*, where it is broken into pieces less than three eighths of an inch in diameter. By mechanical action and running water, waste, which is lighter than ore, is carried away. The concentrator thus changes a mass which is only three per cent copper into a *concentrate* which contains eight per cent of copper.

Next, the concentrates are roasted to burn out most of the sulphur and then placed in large furnaces similar to those used in smelting iron. The result of smelting is copper *matte*, a product containing forty or fifty per cent of copper.

Matte is drawn from these furnaces in a molten condition and carried in huge iron ladles to the *converter*, where it is changed to metallic copper. This is next put through a refining furnace to remove other impurities. When this process is complete, the molten copper is drawn into cast-iron molds which form it into flat plates or *anodes*, weighing about three hundred pounds each. This is known as *blister copper*.

Courtesy Anaconda Copper Mining Co.

Fig. 14. — A portion of the refining plant of the Anaconda Copper Mining Co. at Anaconda

Blister copper is sent to the refining plant at Great Falls (or to Perth Amboy, New Jersey). Abundant water power made Great Falls a suitable place for *electrolytic refining*. By this electric process about twenty ounces of silver and one-fourth ounce of gold per ton are extracted and copper of 99.98 per cent purity is obtained. This is known as *electrolytic copper*. It is melted and cast in various forms, depending upon the purpose for which it is to be used.

4. What the refinery makes from "blister" copper

As you read about the concentration process, it may have occurred to you that some of the valuable ore particles would be carried away by the water along with worthless material. This did formerly happen and such particles were lost until the oil-flotation process was discovered. When certain oils are added to the mixture of water and particles of ore and rock, they stick to the metallic minerals but not to those which are nonmetallic. As the oils are lighter than water, the valuable particles are floated to the surface of the water, where they are recovered. This plan, which may have reminded you of greasing a needle to make it float, seems very simple, but it has saved a great deal of money for the copper

5. How an ingenious process saves waste

industry. Other ingenious methods are in use to prevent waste and new plans are being devised. At present, nothing of great value escapes the smelting and refining processes.

The first copper ores mined in Montana had to be sent to Swansea in Wales to be smelted, and it was not until 1892 that metallic copper was produced in Montana.

6. Science, invention, capital, and skilled labor required in large mines

The story of copper production is one of achievement in overcoming obstacles. It is the story of keen, well-trained men — inventors, scientists, and engineers — and of thousands of intelligent workmen. To operate the great mines so deep in the earth involves problems of safety devices, ventilation, sanitation, and pumping to keep mines dry. Great amounts of capital and skillful management are needed. Such mining is very different from the simple operations of the early gold days.

The story of zinc is like that of copper. For years zinc concentrates had to be shipped to the natural gas fields of Oklahoma for final treatment in purifying the metal.

Why the production of zinc and manganese in Montana is increasing

Manganese, an essential ingredient in production of a very hard and high-grade steel, is mined at Butte and in Granite County near Philipsburg. A plant at Great Falls receives manganese ore and converts it into *ferro-manganese* (iron-manganese). It is used extensively in the steel plants of America and Europe.

Lead ores are found, but most lead produced in Montana comes as a by-product in smelting and refining other ores. A large part of the silver now produced also comes as a by-product, though one of the world's largest silver mines is at Butte. Most of the gold and platinum are also by-products. Sulphuric acid is the most important by-product.

A few important mining by-products

Courtesy Great Falls Commercial Club

Fig. 15. — Electrolytic refining plant, zinc plant, and wire and rod mills at Great Falls

It is used along with phosphate mined in Idaho to produce a high-grade fertilizer. Research is being carried on to perfect methods of utilizing other by-products. At Anaconda phosphates for fertilizers and a host of less important by-products are now saved by scientific methods.

The metal mines at Butte rank among the greatest in the world, but there are productive mines in Beaverhead, Broadwater,

Courtesy Great Falls Commercial Club

Fig. 16. — Coal mine at Stockett, fifteen miles from Great Falls

in the northern and eastern parts of the state. (See main text, page 6.)

Where coal is mined

The largest producing mines of coal are at Roundup in Musselshell County, at Red Lodge and Bear Creek in Carbon County, and at Belt, Stockett, and Sand Coulee in Cascade County. The coal from these large mines is *sub-bituminous*. Much of it is used by the railroads. A great number of smaller mines in nearly every part of the state supply coal, usually of less satisfactory quality. For local fuel needs these mines will doubtless be much more generally developed, especially where hard-surface roads are built.

Cascade, Deer Lodge, Fergus, Granite, Jefferson, Lewis and Clark, Madison, Phillips, and Powell counties. Montana ranks first in production of silver, manganese, and precious stones, and third in copper and zinc.

Montana's rank in copper, silver, gold, and zinc production

Montana is well supplied with coal. Large beds of lignite are well distributed, especially

Oil wells in Montana (Elk Creek Basin) produced nearly 100,000 barrels in 1917. In 1920 the total production in the state was 336,000 barrels; in 1921, 1,435,000 barrels; and in 1922 more than 2,000,000 barrels. In 1923

Oil industry in Montana is new

Fig. 17. — West end of Cat Creek oil field, eastern part of Fergus County

more than one hundred producing wells are reported, most of these being in the Cat Creek and Kevin-Sunburst fields. The depth of wells so far developed varies between 1000 and 2500 feet. Progress in the oil industry makes it impossible to make many statements which are sure to remain true very long. (See pages 36 and 114 of your main text.) Natural gas occurs at Havre, Glendive, and Baker, in the Elk Basin and Kevin oil fields. Billings is supplied with gas from Elk Basin field and Shelby from Kevin.

Limestone, granite, marble for building, phosphates, and graphite are other mineral resources which have been to some extent profitably developed. Precious stones, especially sapphires, have been the source of a considerable income for many years. The fine sapphires bring a high price as ornaments and the smaller ones are used in making watch jewels, a purpose they serve well since they are one of the hardest of substances. Sapphires have been extensively produced in Granite, Lewis and Clark, and Deer Lodge counties, but for many years the largest supply has come from the Yogo Creek district in Judith Basin County. Originally these gems were picked up from various gravels, but the greatest supply now results from grinding the rock in which they occur and exposing it to weathering and the action of water. The total value of the sapphires produced during the most successful year of the industry was nearly a quarter of a million dollars.

How some of our stone resources are used

Facts to be especially well fixed. — 1. Differences between early gold mining and present-day copper mining. 2. How ore is made into copper. 3. Where metals and coal are mined. 4. Where oil and gas are found.

Problems for independent study. — 1. Show how lumbering, grazing, and farming are related to mining.

2. Butte, Anaconda, and Great Falls are the important points in the great mining operations of Montana. What natural geographic conditions account for the fact that these places were selected?

3. If silver is worth one dollar an ounce and gold is worth twenty dollars an ounce, how much more is the silver from a ton of blister copper worth than the gold?

4. Make a list of all uses of copper of which you can think; of gold; of silver; of iron. Which is the longest list? Which do you consider the most useful metal? Why is gold highest in price?

5. Name four different ways in which the development of electricity affected the copper industry in Montana.

Agriculture and stock raising are common to nearly all parts of Montana. — Many early settlers who came to Montana in search of gold were disappointed. As food products were scarce and brought remarkably high prices in mining camps, some of these people very naturally turned to agriculture. Farming was long confined to river valleys in the western part of the state, but settlers later took up many homesteads upon the cattle and sheep ranges. Experience has now shown the advantages and disadvantages of farming in Montana. Compare some of the advantages and disadvantages of farming noted in the following paragraphs with those in western Kansas, as indicated on page 66 of your main text.

How farming began in Montana

We have already noted the fertility of much of the soil, due to the fact that it has not been leached by heavy rains. The long sunlight of summer days and the fact that most of the rainfall comes during the growing season are important. The cool

Conditions favorable to profitable farming

nights decrease danger from rust among grain crops. The large expanses of level or gently rolling land make use of tractors practicable. The price of farm land in Montana is not high; less capital is required to become a landowner than in most farming regions in the United States.

Yet there are many conditions which make farming peculiarly difficult. Occasional alkali spots require expensive treatment before farming can be successfully carried on. In a few places there are large areas of gumbo soil which may possess most of the elements of fertility but seldom produces a crop because of its texture. The annual rainfall is not more than twenty inches in most parts of the state and is often much less, which means that farming as practiced in states where rainfall is abundant is not sure to produce crops. The Chinooks, which may be welcomed in winter, sometimes become the hot winds of summer, parching promising crops in a few days. Within small areas hailstorms are often destructive. Insect pests, especially grasshoppers and cut-worms, affect small areas nearly every year.

Difficulties to be overcome in farming

In spite of these obstacles, agriculture is the most important occupation in the state, often notably successful and sure to be a profitable undertaking when conditions are better understood. The two distinct types of farming common to all of the Western States east of the mountains as described in your main text (irrigation, page 137, and dry farming, page 144) are found in nearly all parts of Montana.

Farming by irrigation developed first near mining camps. It proved so successful that in a few years most of the lowland valleys near the streams were in farms. These early irrigated valleys, such as the Bitter Root, Beaverhead, Deer Lodge, Gallatin, and Yellowstone, have been very important in development of the state.

Where farming by irrigation first developed

The first irrigation projects (main text, pages 136–138) were on a small scale, conducted either by individuals or by several persons in partnership. More recently the Reclamation Service of the United States has been developing new areas of irrigated land on a large scale. Four of these projects, Huntly, Lower Yellowstone, Milk River, and Sun River, known as Reclamation Service Projects, will, when completed, include nearly a half million acres. Three others, the Blackfeet, Flathead, and Fort Peck, known as Indian Service Projects, will

How the irrigated areas have been increased

Courtesy Great Falls Commercial Club

Fig. 18. — Haying on the Valier Irrigation Project

add four hundred thousand acres to the irrigated lands of the state.

There are also six Carey Act Projects, developed by private companies who work under supervision of state officials. These are the Valier, almost entirely in Pondera County, the Teton in Teton County, the "Billings Bench" near Billings, the Big Timber in Sweet Grass County, the Flatwillow in Fergus County, and the Little Missouri near the southeastern corner of the state. In some of these little development work had been done by 1923. The total area of the six is 162,285 acres; about half of this has been taken up by settlers. Because of the many homestead filings made during recent years there is no remaining area in the state large enough for profitable development under the Carey Act or by the United States government under any present laws. Projects in the future will probably be under the coöperative district plan.

What proportion of Montana has been or may be irrigated

About 30,000,000 acres, one third of Montana's area, have been classified as farming land. About 7,000,000 acres are capable of being irrigated. Under irrigation or capable of irrigation projects already started are less than 2,000,000 acres.

How dry farming may be made successful

Dry farming is practiced in parts of the state where water for irrigation is not available. The method of summer fallowing (main text, page 146) is successfully used, one crop being raised every two years. A considerable part of the annual precipitation is in the form of snow, which melts gradually and sinks into the ground without great loss from run-off or evaporation. Since farming is less difficult, other conditions being equal, where the rainfall is comparatively heavy, farms on foothills and benches are more likely to be suc-

Courtesy Montana Development Assn.

Figs. 19–22

Figs. 19–22 illustrate four processes connected with summer fallowing: disking, plowing, packing soil, harrowing. Find out the reason for each process.

Fig. 23. — A cornfield in eastern Montana

cessful than those on the lowlands. Land lying immediately east of mountain ranges is seldom satisfactory for dry farming.

The principal dry-land crop has been wheat. Fall-sown wheat has usually produced a larger yield per acre than wheat planted in the spring, but the acreage of the latter is much greater. It matures earlier, thus being more likely to escape the drought of summer. It is often too dry in the autumn to give winter wheat a start. During "open" winters it is sometimes winter-killed. On wind-swept areas whole fields are occasionally "blown away," and even the earliest maturing winter wheat does not always escape the hot, drying summer winds.

Corn and sun-flowers are increasingly important dry-farming crops, since they may in part be made to serve the same purpose as summer fallowing and, when converted into ensilage, may furnish food for hogs and cattle. In the plains section of the state and in the lower valleys where the growing season and rainfall are sufficient for these crops, the dry-land farmer is less dependent upon small grain crops alone.

The principal grain crops of Montana are wheat, oats, flax, barley, rye, and corn. Wild hay is of an exceptionally nutritious quality. Alfalfa, of which there are from two to four cuttings, is produced in nearly all parts of the state. Timothy and clover are used for hay and pasture.

What crops are most extensively raised

Sugar beets (main text, page 142) are raised in large quantities in the neighborhood of Billings. Potatoes, cabbage, and peas are paying commercial crops. Most garden vegetables thrive, those which require a long frost-free season being more

Courtesy Great Western Sugar Co.

Fig. 24. — A sugar beet field near Billings

generally grown in the eastern half of the state. The growing of such crops as alfalfa, sweet clover, potatoes, and peas for seed is of increasing importance.

The most important fruit section is the Bitter Root Valley in Ravalli County. Its best known fruit is the McIntosh Red apple, which always commands high prices in apple markets. Other important fruit regions are near Flathead Lake, in the vicinity of Billings, and in the valley of Clark's Fork of the Yellowstone. Apples, plums, cherries, and berries are raised successfully in each of these districts.

Natural resources for grazing

The great expanses of grass-covered plains afford opportunities for grazing similar to those of other Plains states. Untillable mountain slopes and small valleys or those which are too isolated for profitable cultivation greatly increase opportunity for raising horses, cattle, and sheep. A large part of the National Forest area is available for grazing. In the mountain region of the state, altitude, cool summers, nutritious grasses, and well-watered ranges combine to grow stock of unusual size and remarkable freedom from disease.

Horse production less important than formerly

Horse raising has diminished in importance and the enormous sales once held annually at Dillon and Miles City no longer bring together thousands of horses for Eastern markets. Horse raising is rapidly becoming like the same occupation in older farming regions. Each farm or ranch may produce horses enough for its own needs with an occasional surplus of a few for sale.

Cattle raising (main text, pages 80 and 146) has also changed. The first market cattle produced in Montana had to be driven long distances, perhaps to Ogden, before they could be loaded upon trains. Settlers were few and far between and the ranchers and cowboys who took care of their herds did nothing else; some of them despised farming and depended upon distant markets for many supplies which could have been produced at home. Large herds were the order of the day.

How cattle raising differs from the same occupation in pioneer days

Courtesy J. W. Johnson

Fig. 25. — Apple orchard in Bitter Root Valley

When we read about some of the large herds of earlier days we are apt to think that many more cattle were produced than are now raised in the state. In this we should of course be wrong, for statistics show a gradual though not uniform increase in cattle production. There are now many more small ranches and farms upon which a few cattle are raised. Many dairy herds are required

Fig. 26. — Grazing land, where plains and mountains meet in central Montana

to supply milk and butter to the increased population of our cities, and many of the large ranches are as large as ever. In fact in some parts of the state, both in the cattle and sheep industry, the largest ranches seem to be increasing in size.

Cattle are often kept upon the range during grazing season and driven to hay-producing valleys for wintering. Thus live-stock raising and agriculture are combined to the advantage of each, since the distance from shipping points may render marketing hay unprofitable. In general the raising of cattle is attended with less loss through starvation and exposure than in the days where only large herds were found, and the quality of stock is being steadily improved.

How grazing and agriculture are related

Cattle raising in Montana encounters several peculiar obstacles. While a severe winter storm no longer means the loss of thousands of cattle, there is more loss than where farm buildings are adequate to protect all stock. An occasional very dry summer shortens the season for grazing and at the same time reduces the hay crop which is depended upon for winter feeding. If feed must be shipped from long distances its cost is likely to take away all profit from the cattle which are being fed. And finally, distance from the great cattle markets makes freight costs

Present problems of cattle industry

Fig. 27. — On a sheep ranch in Beaverhead County

a serious problem, though cheap land and low price of feed during most seasons more than make up for this difficulty.

How sheep production differs from cattle raising

Much of what has been said about cattle production applies also to sheep raising. Sheep, however, bite closer to the ground and can live on range where cattle would starve. Profit upon their wool is not so seriously affected by freight rates because it is not heavy when compared with its value. Montana wool is of fine quality and commands high prices. Montana ranks near the head of the list of states in wool and sheep products.

How increased variety of production affects farming in Montana

Hog raising and poultry production have become occupations of great importance. As more attention is given to corn cultivation it may be expected that pork production will continue to increase. Bee culture is successfully practiced in several farming communities, especially in southern Montana. As dairying and other minor rural industries become more important, the individual farmer is less dependent upon a single resource. Failure in principal crops there may still be, but total failures will seldom occur.

Facts to be especially well fixed. — 1. The two methods of farming in Montana. 2. Principal crops. 3. Changed conditions in stock raising.

Problems for independent study. — 1. Make a list of the favorable and unfavorable conditions for agriculture in the community where you live.

2. It is sometimes possible to increase crop yields by introducing new varieties of grain which may mature earlier or may be more hardy when exposed to frost or drought. Which branch of the University of Montana would you write to for advice as to agriculture? What is an experiment station?

3. Crops are sometimes protected by destroying animal or insect pests. If you had trouble with gophers or grasshoppers, what could you do to save a crop?

4. By study of the table of Montana farm crops in the Appendix find (*a*) the comparative importance of winter and spring wheat; (*b*) the crop which produced the greatest value per acre in 1922; and (*c*) an example of a large crop which had less value than a smaller one the preceding year because of a decreased market price.

5. Using the same table, which of the crops do you think must in part or altogether be shipped out of Montana? What city or cities are the markets? Learn, if possible, the freight rates by the bushel, ton, or carload lot.

6. Account for the fact that more than half the acreage of Montana in small fruits is in Flathead, Ravalli, and Missoula counties (census 1920).

7. From the following table of principal counties producing orchard fruits determine two important orchard sections. Account for their location, using the map.

	Trees of bearing age	Yield in bushels, 1919
Montana	1,161,441	702,523
Ravalli County	778,713	405,253
Flathead County	122,508	54,610
Missoula County	70,569	61,910
Carbon County	61,986	76,616
Yellowstone County	24,438	44,841

8. On page 136 of your main text is a map which shows seven irrigation projects in Montana. Compare their names with the names of projects mentioned in this study of agriculture in Montana. What river makes each project possible?

9. After reading page 45 of the main text, where should you expect Montana's wool clip to be marketed? In manufactured form some of this comes back to Montana. Why is not this manufacturing done nearer where the wool is produced?

10. In general, horse production in Montana is becoming less important and dairying, hog, and poultry raising are increasing. Account for these facts. Are they true in your community?

The development of travel, trade, and manufacturing. — Of the transcontinental railroads in the United States, three cross Montana. Which are these? One of them,

the Chicago, Milwaukee, and St. Paul, uses electric engines run by power generated at several hydroelectric plants (main text, page 152). The electric locomotives are heavier and more powerful than the steam locomotives which they displaced. They are so much more powerful in fact that each one run by electricity can do about three times as much work as a steam locomotive. From Harlowton to a point beyond the western border of the state the "Milwaukee" (C. M. and St. P.) uses only electric power.

How Montana is connected with the East and West

All the transcontinental lines must overcome steep grades and make abrupt curves in crossing the mountains. "Pushers" must be used at certain points upon all but the shortest and lightest trains. One road has a two per cent grade for twenty-one miles. If a train climbs two feet each time it moves one hundred feet, how much higher would it be at the end than at the beginning of its twenty-one-mile climb? Another has a one per cent grade for forty-nine miles. There are many abrupt curves and horseshoe-like bends.

How railroads cross the mountains

On the map these roads appear to travel in a nearly straight direction, but in finding the easiest way over the mountains all are forced to go west, east, north, and south, to follow crooked rivers even when they seem to be going in the wrong direction. At one point in a narrow pass trains pass each other on different lines, going in opposite directions, though the general course of each is from east to west. Travel in the mountainous parts of Montana is peculiarly interesting because of the ever-changing variety of scenery.

Courtesy Chicago, Milwaukee, and St. Paul Railway Co.

Fig. 28. — An electrified railroad line in Montana

The Chicago, Burlington, and Quincy Railroad enters the state from the southeast; it joins the Northern Pacific at Billings, and its trains run on the same tracks or upon those of the Great Northern to the west and north. With what important cities does the "Burlington" (C. B. and Q.) connect Montana?

How Montana is connected with the South

At Butte the Oregon Short Line, a part of the Union Pacific system, connects the other roads with the main lines of the Union Pacific. If you were at Butte, by how many different routes could you start to Chicago? To St. Paul? To San Francisco?

Automobile roads connect important points and reach scenic resorts (Fig. 2). The Yellowstone Trail and the Park to Park Highway are being developed into excellent roads. Though not listed as a resource, Montana's attractions for tourists are increasingly receiving attention. Two great

Automobile roads and attractions for tourists

National Parks are within or bordering upon the state.

More than a hundred thousand persons visit Yellowstone Park each season. Its greatest features of interest are the geysers (main text, page 163), the great canyon, and the opportunity to study wild animals and plants of the mountain region. Bears, deer, and other four-footed creatures and wild birds are protected from hunters. They live about as they did before white men came to the West. The forests have not been disturbed more than is necessary to construct roads and provide hotels and camps for tourists.

1. Yellowstone National Park

Glacier Park is interesting especially for its glaciers, rugged mountains, and picturesque lakes. These two great parks are maintained by the United States Government.

2. Glacier National Park

Yellowstone Park has three principal entrances, Gardiner, Cody, and West Yellowstone. By what railroad is each reached? What railroad reaches Glacier Park?

In addition to these widely known parks, there are many beautiful valleys and impressive mountain ranges, such as the Bitter Root and Mission Range. There are scores of deep, cold, clear mountain lakes and one larger lake, Flathead. Hot springs are found in many counties. Trout fishing is excellent in hundreds of mountain streams.

3. Why tourist business is increasing

The pleasant summers which prevail in a large portion of the state give Montana unusual advantages for summer outings of tourists. In addition to permanent road-building which is extending the main highways, the natural dirt roads are usually good during the touring season. Provisions for the comfort and accommodation of auto tourists are being improved (main text, page 162).

Resources for manufacturing in Montana include first of all the raw materials from mines and quarries, farms and ranches, gardens and orchards, forests and oil wells. Adequate transportation facilities bring together raw materials and distribute finished products. Coal, natural gas, and abundant water power are important items in any consideration of the development of manufacturing in Montana.

Why water power is turned into electric current

Courtesy Glacier Park Photo Shop

Fig. 29. — Lake McDonald, in Glacier National Park

Water power is an increasingly valuable manufacturing resource (main text, page 151). In a sense the power plants are manufacturing enterprises themselves, since they make the fast force of a waterfall useful in a form which creates other products. At each power plant large turbine wheels are connected with electrical generators which develop the electric current.

This is carried by wires to distant towns

Courtesy Chicago, Milwaukee, and St. Paul Railway Co.

Fig. 30. — A large hydroelectric plant at Great Falls

and cities, where it is used for heating and lighting and cooking, running street cars, operating machinery, and driving trains on the Chicago, Milwaukee, and St. Paul and the Butte, Anaconda, and Pacific railroads. Electric power is used in mines and smelters. It is used near the plant where it is produced whenever this is possible, since much of it is lost if it must be transmitted long distances over wires.

1. Work which electric power does

Power plants already completed have a combined capacity of 420,000 horse-power. The principal completed hydroelectric (water-power electric) plants are at the Rainbow Falls, Black Eagle Falls, and Great Falls of the Missouri River near Great Falls; at Hauser Lake, Canyon Ferry, and Holter on the Missouri River, where it breaks through the mountains, all within thirty miles of Helena; at Thompson Falls on Clark Fork of the Columbia; and on the Madison, Big Hole, and Yellowstone rivers. It is estimated that undeveloped power sites may add 3,911,000 horse-power of electric current. Nearly all of the electricity used in Montana is generated by water power.

2. What determines location of water-power electric plants

The most extensive manufacturing enterprises in the State are those connected with the mining industry. The smelting and refining of ores have already been described. At Great Falls copper is made into wire. Copper is thus carried from mine to finished product within Montana. As a by-product of smelting operations, arsenic, sulphuric acid, and acid-phosphate fertilizers are manufactured at Anaconda.

Important industries

Fig. 31. — A lumber mill

Lumber mills, to the number of more than one hundred, are in operation, the most important being at Bonner, Libby, Eureka, and other points in the northwestern part of the state. The average amount of lumber cut in the state annually for the period from 1916 to 1921 was 329,682,000 feet. There is also large production of railroad ties and mine timbers.

The largest flour mills are at Great Falls, Bozeman, and Billings, and there are mills in every wheat-producing section of the state. Meat-packing plants are in operation at Butte, Great Falls, and Billings.

Manufacture of beet sugar at Billings has proved to be a successful industry. Beets are extensively grown in Yellowstone, Rosebud, Treasure, Richland, Carbon, and Stillwater counties upon irrigated land. The crop is harvested in September and October. The factory operates about sixty days each year and employs several hundred men.

Cement is extensively manufactured at Trident in Gallatin County and at Hanover near Lewistown (main text, page 43). Bricks of excellent grade and various other kinds of clay products are made at Lewistown and Helena and a dozen other places. At Ramsey, near Butte, is a plant which manufactures various kinds of dynamite.

Oil refineries at several points near the oil fields use crude oil as it comes from the wells as raw material. From this several commercially important products are made, the principal one being gasoline. As new oil fields are developed, it is probable that oil refineries will become increasingly important.

There are canneries at Bozeman and Stevensville and creameries in many places (54 in all). Nearly every city has small manufacturing concerns which serve the needs of the community. Perhaps you can think of an example of this kind of manufacturing. Such industries are important locally, and occasionally one may expand until it supplies a large territory. The source of raw material, cost of shipping, and the number of people who are within reasonable distance need to be considered in estimating the probable growth of a manufacturing undertaking. With these in mind, it seems that Montana's most important large industries will develop in using raw materials which our state alone can produce or which it can produce at a lower cost than other parts of the country. What are some of these?

Large scale manufacturing in a few centers; local industries in every city

Facts to be especially well fixed. — 1. The transcontinental railroads which cross the state. 2. The important manufactures of Montana.

in western Montana

Problems for independent study. — 1. Describe a railroad journey between points named here, indicating names of railroads and points at which change must be made from one railroad to another:

Polson to Baker	Hamilton to Libby
Polson to Red Lodge	Conrad to Billings
Glendive to Lewistown	Glasgow to Dillon

2. What reasons can you give to prove that important kinds of manufacturing not now carried on in Montana will or will not be developed in the future?

3. In 1922, 1,250,000,000 kilowatt hours of electricity developed by water power were used in Montana. Under favorable conditions three pounds of coal are required to develop one kilowatt hour of electricity by steam power. How many tons of coal would have been consumed in developing this amount of power by steam? What would the coal be worth at six dollars a ton?

4. What are the most important commodities shipped into the town in or near which you live? Which of them come from other Montana communities? Which are manufactured goods and which are raw material?

5. What are the most important products shipped out of the city in or near which you live? Where are these sent?

What provision is made for schools? — In education Montana holds high rank. Every city and town has grade and high schools. School buildings are usually modern, comfortable, and well equipped. There are nineteen (1923) county high schools. All high schools, whether county or city, are supported by a county tax and are free to all pupils who live within the county. In many villages and towns the schoolhouse is by far the best building and is the pride of the community.

Why Montana ranks high in education

Rural schools differ very greatly in equipment. In some the best of school work is being done. In some one-teacher schools there are not more than five pupils and in more than a third of the schools, not more than ten. Excellent work may be done in such small schools, but the cost per pupil is very great. In some localities rural schools are being consolidated into larger districts; but in many sparsely settled regions this plan is not practicable.

Some rural school problems

Courtesy Great Falls Commercial Club

Fig. 32. — A junior high school at Great Falls

The per cent of illiteracy in Montana, that is, the number per hundred persons more than ten years of age who cannot write in any language, regardless of ability to read, is 2.3. The per cent for the United States is 6.0. The total illiteracy of Montana in 1920 was 9544.

The per cent of illiteracy is decreasing

The state provides advanced training in the University of Montana. This includes the State University at Missoula, State College at Bozeman, State School of Mines at Butte, and State Normal College at Dillon. Each specializes in training for certain professions or occupations. These institutions have grown rapidly in recent years and many new buildings have been provided by the people of the state, who have thus shown that they believe in providing the best of training for Montana young men and women.

Where high school graduates continue their education

Education is furnished for incorrigible boys in the Industrial School at Miles City and for incorrigible girls at the Girls' Vocational School near Helena. For the unfortunate, Montana makes provision in the Orphans' Home at Twin Bridges; for the Deaf, Blind, and Feeble-minded, at Boulder. The State Hospital for the Insane is at Warm Springs, the State Tuberculosis Sanitarium at Galen, and the State Penitentiary at Deer Lodge.

Special institutions provided by the state

The chief cities of Montana. — The population of Montana in 1920 was 548,889. In 1910 it was 376,053. What was the per cent of increase during the ten years? Of the total population (1920), 307,179 lived in the country and 241,710 in the cities and towns whose population is given in the statistics which follow. Nearly one third of the population lives in cities of more than 2500 inhabitants. Many places of less than 2500 are very important because they are trading centers for large areas. They are very different from towns of equal population in older sections of the country. (See main text, page 152.)

BUTTE (41,611) is the mining center of the state. In addition to the large mines there are hundreds of smaller ones. Although several minerals are produced, copper is by far the most important. When the price of copper is low, many of the mines cease to operate; when copper is high, nearly all mines are worked and new prospects are developed. Because of the unusual opportunity for immediate acquaintance with mining, the State School of Mines is in Butte.

The main lines of two transcontinental railroads pass through Butte. A branch of the Great Northern connects with the main line in the northern part of the state, and the Oregon Short Line connects with the Union Pacific in Idaho and Utah. The Butte, Anaconda, and Pacific unites Butte and Anaconda and carries ore to the smelter. Butte is thus the principal railroad center of Montana. Though mining is its chief industry, its railroad advantages make it an important wholesale and distributing center.

GREAT FALLS (24,121) derives the name from its location near the "great falls" of the Missouri River. It is the most important railroad center of northern Montana. Its water power, the coal fields

Fig. 33. — Copper mines at Butte

of Belt, Stockett, and Sand Coulee, clay for making brick, building stone, important oil fields in adjacent territory, and the great communities of farms and ranches tributary to it give Great Falls many advantages as a manufacturing and distributing center. Its flour mills are the largest in the state. The metal refineries, packing houses, brick yards, a wire mill, and railroad shops make work for thousands of employees. Great Falls is justly proud of its well-laid-out streets and beautiful park system.

BILLINGS (15,100) is the center of a large area of irrigated farm land. It has numerous local manufacturing industries. Commercially the most important of these is the making of beet sugar. As an important railroad center, Billings is the wholesale

Fig. 34. — A general view of Billings

and distribution point for a large section of southern and eastern Montana.

Missoula (12,668) is the trading center for a large part of the Flathead, Blackfoot, Hell Gate, Bitter Root, and Grass valleys. Two transcontinental railroads here make their way through the only gap in the mountains, and branch lines give convenient access to the valleys just noted. Lumber and forest industries are important. The State University is at Missoula.

Helena (12,037) as the seat of state government is important politically. Many business corporations direct their Montana enterprises from Helena headquarters. Several religious denominations manage their organizations from Helena. Helena may thus be called the governing center of the state in other than political respects. Montana Wesleyan College and St. Charles College are in Helena. The State Fair and the State Vocational School for girls are also here. Mining, once the only industry in Last Chance Gulch, is still of importance, a custom smelter being at East Helena. Helena is the shipping and distributing center of an agricultural section.

Anaconda (11,668) is the "smelter city." Most of the ore mined at Butte is sent to Anaconda. Many useful by-products are made in addition to copper, which is the most important. The Washoe smelter of the Anaconda Copper Mining Company is said to be the largest ore-reducing plant in the world.

Miles City (7937) is the largest town in eastern Montana. It is the center and distributing point of a large agricultural and grazing region, and a great cattle market. The State Industrial School for boys is at Miles City.

Livingston (6311) has large railroad shops, and is a center of tourist traffic for those who visit Yellowstone Park.

Bozeman (6183) is the center of the rich Gallatin Valley. Milling is important. The State College of Agriculture and Mechanic Arts is at Bozeman.

Lewistown (6120) is important as the market of one of the principal grain-growing sections of the state. Brick and tile are manufactured here. One of the chief oil fields is tributary to Lewistown.

Havre (5429) is the largest city on the main line of the Great Northern Railroad. It has the advantage of being near newly developed oil fields. It has natural gas wells.

Kalispell (5147) is the center of agricultural, horticultural, grazing, and lumbering interests of Flathead County.

Red Lodge (4515) is the center of the coal-mining industry of Carbon County.

Glendive (3816) has division railroad shops and is a shipping point for wheat, oats, and barley raised on the Lower Yellowstone Irrigation Project. Glendive is supplied with natural gas.

Deer Lodge (3780) has railroad shops. It is the trading center of an agricultural and grazing region. The State Prison is located here.

Whitefish (2867) is a tourist center and a railroad division point.

Dillon (2701) is the center of a sheep and cattle region, and seat of the State Normal College.

APPENDIX[1]

AREA AND POPULATION OF COUNTIES

(According to United States Census of 1920. Items marked * are official estimates in cases of new counties or change of boundaries)

County	Land Area in Square Miles	Population	County Seat	Altitude of County Seat	County	Land Area in Square Miles	Population	County Seat	Altitude of County Seat
Beaverhead	5,657	7,369	Dillon	5,098	Mineral	1,230	2,327	Superior	2,720
Big Horn	4,966	7,015	Hardin	2,966	Missoula	3,173	24,041	Missoula	3,223
Blaine	4,229	9,057	Chinook	2,407	Musselshell	2,903	12,030	Roundup	3,184
Broadwater	1,206	3,239	Townsend	3,813			*8,330		
Carbon	2,060	15,279	Red Lodge	5,537	Park	2,661	11,330	Livingston	4,491
Carter	3,375	3,972	Ekalaka	3,000 est.	Phillips	5,178	9,311	Malta	2,248
Cascade	3,411	38,836	Great Falls	3,330	Pondera	1,658	5,741	Conrad	3,501
		*37,145			Powder River	3,337	3,357	Broadus	3,050 est.
Chouteau	4,213	11,051	Fort Benton	2,565	Powell	2,329	6,909	Deer Lodge	4,519
Custer	3,741	12,194	Miles City	2,371	Prairie	1,742	3,684	Terry	2,250
*Daniels	*1,422	*5,480	Scobey	2,458	Ravalli	2,391	10,098	Hamilton	3,571
Dawson	2,359	9,239	Glendive	2,071	Richland	*2,103	8,989	Sidney	1,978
Deer Lodge	745	15,323	Anaconda	5,288	Roosevelt	2,353	10,347	Wolf Point	1,922
Fallon	1,608	4,548	Baker	2,936	Rosebud	4,993	8,002	Forsyth	2,515
*Fergus	7,178	28,344	Lewistown	3,960	Sanders	2,861	4,903	Thompson Falls	2,462
	*6,026	*25,808							
Flathead	6,109	21,705	Kalispell	2,946	Sheridan	2,686	13,847	Plentywood	2,046
Gallatin	2,507	15,864	Bozeman	4,771		*1,758	*9,376		
Garfield	4,837	5,368	Jordan	2,800 est.	Silver Bow	726	60,313	Butte	5,767
Glacier	2,981	4,178	Cut Bank	3,698	Stillwater	1,777	7,630	Columbus	3,698
*Golden Valley	*1,175	*4,276	Ryegate	3,638	Sweet Grass	1,969	4,926	Big Timber	4,072
Granite	1,717	4,167	Philipsburg	5,175		*1,932	*4,452		
Hill	2,884	13,958	Havre	2,480	Teton	2,044	5,870	Choteau	3,810
Jefferson	1,632	5,203	Boulder	4,919	Toole	1,958	3,724	Shelby	3,286
*Judith Basin	*1,894	*4,283	Stanford	4,270	Treasure	960	1,990	Hysham	2,667
Lewis & Clark	3,447	18,660	Helena	4,157	Valley	5,447	11,542	Glasgow	2,093
Liberty	1,451	2,416	Chester	3,132		*5,064	*10,533		
Lincoln	3,624	7,797	Libby	2,053	Wheatland	1,411	5,619	Harlowton	4,163
McCone	2,645	4,747	Circle	2,800 est.	Wibaux	883	3,113	Wibaux	2,635
Madison	3,622	7,495	Virginia City	5,822	Yellowstone	2,611	29,600	Billings	3,117
Meagher	2,369	2,622	White Sulphur Springs	5,000					

[1] Up-to-date information regarding Montana's resources, valuable in bringing statistics up to date each year, may be found in the annual number of the publication "Montana," issued by the Montana State Department of Agriculture.

POPULATION OF MONTANA CITIES HAVING MORE THAN 2500 INHABITANTS

(United States Census of 1920)

City	Population	City	Population	City	Population	City	Population
Butte	41,611	Anaconda	11,668	Lewistown	6,120	Glendive	3,816
Great Falls	24,121	Miles City	7,937	Havre	5,429	Deer Lodge	3,780
Billings	15,100	Livingston	6,311	Kalispell	5,147	Whitefish	2,867
Missoula	12,668	Bozeman	6,183	Red Lodge	4,515	Dillon	2,701
Helena	12,037						

POPULATION OF INCORPORATED PLACES WITH LESS THAN 2500 INHABITANTS

(United States Census of 1920)

City	Population	City	Population	City	Population	City	Population
Antelope	285	Denton	431	Lambert	287	Scobey	1,170
Bainville	396	Dodson	365	Laurel	2,239	Shelby	537
Baker	1,067			Dibby	1,522		
Bear Creek	744	Ekalaka	433	Lima	476	Sheridan	538
Belgrade	499	Eureka	1,082	Malta	1,427	Sidney	1,400
		Fairview	513			Stanford	300
Belt	967	Forsyth	1,838	Manhattan	591	Stevensville	744
Big Sandy	589	Fort Benton	1,065	Medicine Lake	292	Terry	794
Big Timber	1,282			Melstone	477		
Boulder	682	Froid	410	Moore	355	Thompson Falls	508
Bridger	679	Fromberg	520	Nashua	272	Three Forks	1,071
		Geraldine	354			Townsend	897
Broadview	191	Geyser	230	Neihart	749	Troy	763
Browning	986	Glasgow	2,059	Outlook	295	Twin Bridges	755
Cascade	465			Philipsburg	1,724		
Chester	402	Grass Range	262	Plains	452	Valier	613
Chinook	1,217	Hamilton	1,700	Plentywood	888	Virginia City	342
		Hardin	1,312			Walkerville	2,391
Choteau	1,043	Harlem	721	Plevna	241	Westby	253
Clyde Park	352	Harlowton	1,856	Polson	1,132	White Sulphur Springs	574
Columbia Falls	611			Pony	242		
Columbus	987	Hingham	154	Poplar	1,152	Whitehall	629
Conrad	988	Hysham	360	Ronan	600	Wibaux	611
		Ismay	344			Winifred	262
Culbertson	547	Joliet	440	Roundup	2,434	Winnett	316
Cutbank	1,181	Judith Gap	522	Ryegate	405	Wolf Point	2,098
Darby	325			Saco	425		

MONTANA FARM CROPS, 1921, 1922

(From United States Department of Agriculture, Bureau of Agricultural Economics)

Crop	Year	Acres	Bushels per Acre	Average Price per Bushel	Total Value
Winter wheat	1921	425,000	14	.85	$5,058,000
Winter wheat	1922	386,000	16.5	.89	5,668,000
Spring wheat	1921	2,290,000	12	.85	23,358,000
Spring wheat	1922	2,313,000	14.7	.89	30,261,000
Oats	1921	618,000	24	.34	5,043,000
Oats	1922	600,000	32	.37	7,104,000
Corn	1921	190,000	20	.67	2,546,000
Corn	1922	219,000	25	.53	2,902,000
Flax	1921	110,000	5	1.40	770,000
Flax	1922	127,000	7	1.97	1,751,000
Barley	1921	75,000	20.5	.60	923,000
Barley	1922	77,000	25	.50	962,000
Rye	1921	116,000	11.2	.53	688,000
Rye	1922	126,000	14.5	.54	987,000
Potatoes	1921	41,000	115	.80	3,772,000
Potatoes	1922	46,000	126	.40	2,318,000
Apples	1921	.....	.....	1.50	1,465,000
Apples	1922	.....	.....	1.00	610,000